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On the PROVINCE *of the* STATISTICIAN.

By J. J. FOX, *Fellow of the Statistical Society.*

[Read before Section (F), Economic Science and Statistics, of the British Association, Oxford, 2nd July, 1860.]

AMONG the many interesting matters that have impressed me, in listening to the discussions that have taken place in this Section, not one has done so more forcibly than the discrepancy of view that prevails amongst us, respecting the position and limits of the several sciences committed to our care. It is with the view of giving a little clearness to these important points, that I venture to submit the following short paper to your notice.

The title that has been given to our Section, and under which we sit, is "Economic Science and Statistics." Now, if there were any one name that embraced both these particulars, it would probably have been employed. But there is none. Any name that can be thought of, would either include a greal deal more, or, on the other hand, would exclude important branches of science which have able cultivators amongst us.

I ask why it is that there is no common name that includes the whole of our investigations;—and reply, that it is because the things included are essentially different in their nature. They fall into two groups. The first group is truly a Science, and a very large one. It is Economic Science, and inquires into the relations of man to man; in the first place as a member of society, as husband, father, friend, and neighbour—this is *Social Economy;* in the second place, into the relations of man as citizen, as unit of a commonwealth; and this, if the name had not by usage been restricted, should be *Political Economy.* The whole subject of the social and political relations of man, should be included in Economic Science. It should embrace on the one hand the great subject of Education; on the other, that of Legislation, and the limits within which legislation should be restricted. I do not mean the *Arts* of Education and Legislation, but the Sciences on which those arts, to be successful, must be based. It may be objected that these departments of human knowledge involve considerations of an ethical character, resting on the ideas of "duty." They do so. But this interpenetration of two mutually coexisting sciences, does not destroy

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Note.—The following paper must be regarded rather as a "pièce de circonstance" than as an attempt to treat exhaustively the important subjects on which it touches. It was written hastily to meet the differences of opinion that had made their appearance in the Committee of the Section.

the identity of each. In this case, the two departments of human knowledge belong to utterly different categories of science. The first, Economic Science, is concerned with "existence," or belongs to the department of Ontology; the second, Ethics, rests on the idea of obligation, or "duty,"—a term to which Bentham was opposed, and which he replaced by classing such sciences under the new name Deontology. Such interpenetration does not destroy the existence of social and political economy as large sections of the great science of man.*

But there is a practical difficulty in the employment of the names I have used. It has so happened that one part of human relations, from its vast magnitude and importance, has attracted far more attention than other parts, and been almost exclusively studied. It is that of the results flowing from the exchange of productions between man and man, between country and country, and consequent formation, accumulation, and distribution of Wealth, whether personal or national. To this large and valuable science, branch as it is of the wider division of Anthropology to which I have alluded, the name "Political Economy" is very often restricted. The restriction, though not based on abstract scientific arrangement, has become, perhaps, too confirmed for correction.

Let us consider now the second part of our title—"Statistics." This stands in an entirely different position from Economic Science. It can hardly be said to be a "science" at all. Economic Science can deduce general laws from the facts of man's social and political life. Statistics has no facts of its own; in so far as it is a science, it belongs to the domain of Mathematics. Its great and inestimable value is, that it is a "method" for the prosecution of other sciences. It is a "method of investigation" founded upon the laws of abstract science; founded on the mathematical theory of probabilities; founded upon that which has been happily termed the "logic of "large numbers." Resting on these foundations, it is an instrument adapted to aid the inquiry into Truth in a great many distinct and independent sciences.

In making a "method" or instrument a common bond of union between scientific men, we are not singular. The microscope is an instrument for the investigation of science, and is applied to a large circle of objects. It is applied to the sciences of Zoology and Human Anatomy, Physiology and Pathology; to the science of Vegetable Anatomy; to Crystallography and the structure of Geologic rocks. It seems an anomaly to form a Society for the study of things that are small, and yet in practice this bond of union is convenient. The Microscopical Society flourishes, not for the sake of the science of the microscope, which is a department of Optics, but for the investigation of the several matters to which the microscope is applied.

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* Query, might not a *slight infusion* of the ethical element be sometimes useful in the disquisitions of the Economist? If it found its way there, perhaps the sarcastic remark of Burke could with less justice be applied to him.

That which has been found convenient among those who handle the microscope, has equally recommended itself to the employers of the Statistical method. This "method" is the common bond in Statistical Societies, while the objects, to the investigation of which it is applied, are exceedingly different in their nature. And this must be so, since it is applicable to every subject in which large numbers of similar facts or phenomena can be accumulated and made the basis of reasoning. First and foremost, it is applicable to the great facts of social and political economy, and for this reason Economic Science and Statistics have been linked together. The facts of Economic Science are of all facts the most amenable to the Statistical method of inquiry. But in the second place, it is applicable to the phenomena of birth, death, and the continuance of the species. Now these form a part of Human Physiology. It is impossible they can be correctly considered and interpreted without it. The physiology of a population and the physiology of an individual are parts of the same science, according to any natural division. And yet so different is the method employed in the two departments, that it has been found convenient to separate the former and raise it to the rank of an independent science under the name of "Vital "Statistics." Of this, Mortuary Statistics is a branch, which has been cultivated for the sake of its connection with two important arts; for medicine it lays a sound pathological basis by collecting the causes of death;—and it has called into existence an art that has been largely developed of late years—that of calculating from the rate of mortality under various circumstances, the amount of payment that will render the assurance of life profitable and safe.

But there are several other sciences to which the method of large numbers is applicable. Meteorology must, to a large extent, be treated statistically; so must Astronomy, so also Engineering and practical mechanics, and yet we do not commonly regard the labourers in these fields as Statisticians. In their investigations they employ the numerical method, why then are they excluded? The answer must be, that their exclusion does *not* depend on the grounds of strict scientific classification, but partly on the fact of their having been independently studied *before* the growth of the modern Statistical method, and consequently having received a local habitation and a name;—and partly on the feeling that it is *convenient* to employ the term Statistics, only when the method is employed on matters of human life and human interest.

A certain arbitrariness therefore belongs to the term "Statistics."

Being in reality a method and not a science; when it is used to mark a cluster of sciences, it is merely a term of convenience. As it is it brings together some strange bedfellows. Side by side, in the same section, are the pure political economist (whether inductive or deductive, as he hardly knows himself,* I will not presume to decide), and the humbler cultivator of human physiology by the numerical method. Let us endeavour to bear with one another;—and more than this, let us also consider, while pursuing our own special department, whether there may not be a meeting point on which we may help one another. On one topic we are both interested, —the improvement of our "method." Our method is an instrument, like the microscope of the observer in biology, like the calculus of the thinker in abstract science. But our method has been much abused; its power has caused it to be employed, not always in the interest of truth, but sometimes to bolster up a preconceived opinion. If it had not been felt to be powerful, it would not have been so much employed; being employed, and that unskilfully, it has often cut the finger of the operator, and what is worse, has itself incurred odium, as an unsafe or misleading guide.

Now, in a great many cases, this arises from an entire misconception of its office. It is not Statistics, but the science to which the Statistical method is applied,—whether that science be Political Economy or Human Biology,—that is answerable for the *inferences* drawn from what are called "Statistical facts." A large number of phenomena (or "simple facts") grouped together, form a "Statistical fact;" from this, and from other similar or comparable Statistical facts, inferences may be drawn; but the drawing those inferences belongs to the science to which the Statistical method is applied. The service of Statistics, truly considered, has ceased; it does not ascend to causes, though the compound facts that it establishes may often suggest them.

The whole art of safe Statistics consists in deriving legitimate *Statistical* facts from scattered *Solitary* facts. *In the first place*, these facts must be numerous. No collection that is not large deserves to rank as a Statistical fact. This is a point susceptible of mathematical definition, and the formula laid down by Poisson most satisfactorily expresses the degree of exactness attained by any number of aggregate phenomena. It is most important to bear this in mind; and yet it is very commonly overlooked. Inferences are drawn from a number of facts too small for the elimination of casual fluctuations;

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* This alludes to a debate in a former sitting of the Section, in which Mr. Fawcett attacked Dr. Whewell's published views on the method of Political Economy, and Dr. Whewell ably defended himself. Of course, if the subject be philosophically pursued, both induction and deduction must enter into the processes employed.

and without this, the Statistical facts derived are almost worthless. Instances of the neglect of this precaution are abundant. Even many cultivators of what is called by courtesy " Statistical science," are hardly aware of the large number of solitary facts that are requisite to make some classes of conclusions justifiable. An instance of this is to be met with in the ratio of the sexes at birth. Inferences from a few thousand births are taken as valid, but are really worth little by themselves. When the observer ascends to tens of thousands and hundreds of thousands, he finds that what he supposed was the manifestation of some law of physiology, sinks into the mere casual fluctuation, and his result approaches that of other observers who have similarly used large collections of facts.

A *second* important principle is this, that *within the class* of facts observed there must be no voluntary selection, and great care must be taken before employing the Statistical fact for any scientific inference, that any involuntary selection be appreciated and allowed for. Examples of the fallacy springing from neglect of these precautions are sure to occur to any one who has been engaged in Statistical inquiry.

A *third* caution springs from the preceding, and is quite as commonly infringed. It is, that the *mode of collecting* two sets of Statistical facts *must be similar* to make their comparison just. I will give an instance of this from the Times newspaper. A year or more ago, in one of its lively articles on a Report of the Registrar-General on the Mortality of London, it noticed the amusing "fact" so called, that out of *so many* annuitants only a very minute number died in the year. Of course, the "Times" did not believe this to be a fact; but the inference it implied, if it did not draw, was this,—" What is the use of your Statistics, if this is the kind of facts you " give us ?" Now, the fallacy lay in this ;—the *mode of collection* of the Occupation Returns, and of the Death Returns, was quite different. In 1851, individuals returned their own occupations, and each knew very well whether he was an annuitant or a person of independent property, and could, if he chose, return himself accordingly. But the registration of death is made by an informant—generally a servant of the deceased—and neither he nor the registrar who enters the fact of death, can say whether the deceased's independence sprang from annuity or from property. The error arises from putting in comparison Statistical facts collected in two different modes.

A *fourth* caution may be said to belong to all investigation; but it is especially needful in numerical inquiry. It is that of strictly adhering to the exact name of the Statistical fact employed, and not assigning to it another name, derived from some theoretical identity with another Statistical fact. A striking instance of the fallacy flowing from neglect of this precaution is the following, which is by no means uncommmon. In the science of Vital Statistics, the average age at death is erroneously confused with the mean duration of life. Now, these two statistical elements are by no means identical. They are only so under certain conditions of a population, which practically never exist. I know of no population in which the mean age at death is the same as the mean duration of life. The difference is often very great, and the error from the misuse of these names has crept into many scientific papers. I will mention one. A year or two ago, a paper was published in the transactions of a philosophical society of considerable repute, in which, among other errors, the mean age at death of a limited population living in the country, was compared with the mean age at death of the population of the same class (I allude to the Society of Friends), living in towns. The author assumed that these numbers expressed the duration of life in country and town, and found a wonderful shortening in the lifetime of the latter. Here was an evidence of the insalubrity of town-residence, even when combined with all the palliating circumstances of middle-class comfort. But the whole train of reasoning was rotten. The class, whose deaths were collected, have been for many years sending off their young people to the towns, where the said young people marry and have families; while those remaining in the country consist largely of the non-marrying and the old. No wonder the average age at death of the town-residents falls many years below that of residents in the country.

A *fifth* leading principle in our method, is to remember that every Statistical fact has its basis, and that this basis must be constantly kept in view in its employment. The base is to the fact as the denominator to the numerator of a fraction, and gives it its true character and significance. Without the basis it is nothing. I will illustrate my meaning thus:—

That A. B. dies is a solitary fact;

That *so many* individuals die in England in one year, is a Statistical fact of the *first* order;—but,

That *so many* die in England in one year, to every 100 of the population, is a Statistical fact of the *second* order, and obtained by using the population as a denominator.

It is the use of this Base, the number, time, and locality in which such and such facts occurred, that it is most important to keep in mind in Statistical reasoning. I could give instances of amusing blunders arising from neglect of it;—facts placed side by side and compared, when they were derived from quite different bases;—when they were, in fact, fractions with different denominators. No wonder that inquiries conducted in this manner lead sometimes to singular results.

I will now conclude this notice of some of the sources of fallacy that are of frequent occurrence in the use of this modern and truly valuable instrument of investigation. I imagine you will agree with me as to its importance and as to the principles that should preside over its application. But I apprehend that you are not prepared to admit my views as to Statistics not being a science in itself (its position as a section of mathematics or of logic excepted). I can only say that no attempt to define it as a science, that I have met with, has been successful. If it be made, as is commonly done, something coincident with what I have called "social economy," it will exclude many departments that are universally admitted to belong to it.

In treating the subject hastily at the present time, I feel that I have done it most insufficient justice. The expression of thought on such abstract subjects as the classification and mutual relation of the sciences, demands considerable time and explanation. But the views have not been suddenly adopted, although it is only the discussions of the last few days that have induced me to put them on paper. I hope that they will promote our friendly co-operation, by showing the common ground that connects the pure Economist and his humbler Statistical brethren. Both he and they, when they leave the lofty heights of abstract truth, and take cognizance of the phenomena to which their science relates, make use of the same tools, though they may quarry in very different formations. It is not so much any affinity that exists between the matters on which they work that links them together, as it is their using the same instruments,—carving, by the aid of laborious induction from numerical facts,—here a foundation stone,—here a pillar,—here a turret,—each adapted for its place in the One majestic Building of Science.